BMP #137 - Sedimentation Trap (Basin)

DESCRIPTION

A temporary or permanent dam or basin used to collect, trap, and store sediment produced by construction activities, or as a flow detention facility for reducing peak runoff rates. Sediment basins can be designed to maintain a permanent pool or to drain completely dry. Either way, the basin detains sediment-laden runoff long enough to allow most of the sediment to settle out.

A sediment basin can be constructed by excavation or by placing an earthen embankment across a low area or drainage swale. The pond has a riser and pipe outlet with a gravel outlet or spillway to slow the release of runoff and provide some sediment filtration.

Targeted Pollutants

- ● Sediment
- ○ Phosphorus
- ◒ Trace metals
- ○ Bacteria
- ○ Petroleum hydrocarbons

Physical Limits

Drainage area	5 ac
Max slope	10%
Min bedrock depth	3 ft
Min water table	2 ft
SCS soil type	BCD
Freeze/Thaw	good
Drainage/Flood control	no

APPLICATIONS

Sediment traps are appropriate where physical site conditions or land ownership restrictions preclude the effective use of barrier-type erosion control measures. It may be used below construction operations which expose critical areas to soil erosion.

A temporary sediment basin used in combination with other control measures, such as seeding or mulching, is especially effective for removing sediments.

Note that the use of sedimentation basins on construction sites greater than or equal to 5 acres with an NPDES stormwater permit has special requirements. Refer to Part IV.D.2.a.(2)(a) of the NPDES stormwater general permit for onsite activities.

LIMITATIONS

- May not be feasible downstream of narrow right-of-way due to lack of space.
- May not be practical in highly erodible soil types (0.01 and smaller, very fine sand, silt and clay) due to extremely large basin size requirements.
- May not remove enough of the fine silts. Additional control measures such as filter cloth around riser should be used to minimize release of fine silts. If filter cloth is used, regular inspection and replacement is required to deal with clogging.
- Should not be located in any active stream channel.

DESIGN PARAMETERS

Design of the basin should be based upon the total drainage area lying upstream and (if permanent) on the future use of such lands. Design should be approved by a professional engineer.

The volume of the sediment basin should be at least 1800 ft^3 /acre (125 cubic meters per hectare) of total drainage area (about 1/2 in (13 mm) over the watershed). Disturbed areas greater than 10 acres (4 hectares) within the same drainage basin should be provided a basin with a capacity of 3600 ft^3 (250 cubic meters) per hectare of total drainage area (1 in (25 mm) over the watershed) to meet the NPDES regulations.

The basin should be designed with baffles or other deflectors to spread the flow throughout the basin. It should also include an emergency spillway and riser pipe(s). These structures must be designed on a site-specific basis using standard engineering practices. The basin pond must be sized by calculating the settling zone volume and adding the necessary sediment storage volume. The settling zone volume is determined by the pond surface area calculated using the following equation:

$SA = 1.2Q_x / V_{sed}$

Where:

SA = the pond surface area in square meters

Q_x = the design inflow (in cubic meters per second) based on the runoff from the design storm event for the drainage area.

V_{sed} = the settling velocity for the design soil particle in meters per second. The following table lists theoretical settling velocities for different particle sizes (#200 sieve=0.074 mm).

Size in (mm)	V_{sed} in/sec (m/sec.)
0.02 (0.5)	0.0023 (0.058)
0.008 (0.2)	0.00079 (0.020)
0.004 (0.1)	0.00028 (0.007)
0.002 (0.05)	0.000079 (0.002)
0.0008 (0.02)	0.000012 (0.0003)
0.0004 (0.01)	0.0000028 (0.00007)
0.0002 (0.005)	0.00000079 (0.00002)

For particle sizes of 0.01 and smaller, the V_{sed}'s are so low that the SA becomes extremely large, often making the overall basin size requirement too large to be practical. In this case, extra protection

measures should be taken to negate the need for the basin.

The settling volume requirement is then calculated by multiplying the surface area by the settling depth. The settling depth must be a minimum of 1 ft (0.6 meter) and a maximum of 4 ft (1.2 meters) and is governed by a relationship with the basin length (distance from the inlet to the outlet). The ratio of length to settling depth should be greater than 200. For example, if the length was (120 meters), the settling depth must be less than 2 ft (0.6 meters) to achieve the ratio of greater than 200.

Typically, a sediment storage depth of 3 ft (1.0 meter) is appropriate unless large volumes of soil are expected from highly erodible site conditions. In this case use the "universal soil loss equation" or other applicable estimating methods to design the storage depth on a site-specific basis.

Determine the final pond dimensions and volume as follows:

1) Determine the pond geometry for the sediment settling volume calculated above by adding a sediment storage depth of 3 ft(1.0 meter) and 3:1 side slopes from the bottom of the basin. The bottom must be level.

2) Extend the side slopes (at 3:1) as necessary to obtain the settling zone volume at the settling zone depth determined above.

3) Adjust the geometry of the basin to effectively combine the settling zone volume and sediment storage volume while preserving the depth and side slope criteria listed above.

Sediment basins covered by this standard should be limited to the following category:

The water surface at the crest elevation of the pipe spillway should not exceed 10 ft (3 meters) measured upward from the original stream bed to the crest elevation of the pipe spillway; and the drainage area should not exceed 150 acres (60 hectares).

Because finer silts may not settle out completely, additional erosion control measures should be used to minimize release of the fine silt. Runoff should enter the basin as far from the outlet as possible to provide maximum retention time.

CONSTRUCTION GUIDELINES

The temporary sediment basin should be installed before clearing and grading is undertaken. It should not be built within an active stream channel. Putting a dam in such a site could destroy aquatic habitat, and failure of the dam could result in flooding. A temporary sediment basin should be constructed only if there is sufficient space and appropriate topography. The basin should be made large enough to handle the maximum expected amount of site drainage. Fencing around the basin may be necessary for safety reasons or to discourage vandalism.

The following general construction criteria are critical to successful installation and operation of sediment basins.

- Locate the dam to provide maximum volume capacity for silt behind the structure.

- Prepare the dam site by clearing vegetation and removing topsoil before beginning dam construction. Areas under the embankment and any structural works should be cleared and grubbed, and the topsoil stripped to remove all trees, vegetation, roots and other objectionable material. To facilitate cleanout and restoration, the pool area (measured at the top of the pipe spillway) should be cleaned of all brush, trees or other debris.

- Level the bed for the pipe spillway to provide uniform support through its entire length under the dam.

- Construct an emergency spillway (as per design) on undisturbed soil--not on fill. The design width and entrance/exit channel slopes are critical to the spillway's ability to successfully protect the dam with a minimum of erosion hazard in the spillway channel. The spillway should be lined with

  4 in (100 mm) of concrete, reinforced with 6 X 6 in (150 mm x 150 mm) 10/10 wire mesh extending to a minimum of 36 in (900 mm) down each face of the embankment. The spillway should be at least 20 in (500 mm) deep with 1:1.5 slide slopes.

- All pipe joints must be securely fastened and watertight. The riser should be rigidly and securely fastened to the barrel and the bottom of the riser should be sealed (watertight). The barrel should be placed on a firm foundation according to the lines and grades shown on the plans.

- Place at least 1 ft (600 mm) of hand-compacted backfill (maximum 6 in (150 mm) lifts) over the pipe spillway before crossing it with construction equipment. The movement of the hauling and spreading equipment over the fill should be controlled so that the entire surface of each lift will be traversed by not less than one tread tract of the equipment.

- The pipe spillway should discharge at ground elevation below the dam, and not more than 12 in (300 mm) above any streambed.

- Fill material should be taken from approved designated borrow areas, and should be of the type and quality conforming to that specified for the adjoining fill material. It should be free of roots, woody vegetation, oversize stones, rocks exceeding 6 in (150 mm) diameter, or other objectionable materials. Do not use frozen material.

- Areas on which fill is to be placed should be scarified prior to placement of fill. Fill materials should be placed in 6 in (150 mm) maximum lifts, compacted by construction equipment. The embankment should be raised and compacted to an elevation which provides for anticipated settlement to design elevation (allow at least 10 percent for settlement). Lifts should be continuous over the entire length of the fill and approximately horizontal.

- Stabilize the embankment and emergency spillway with revegetation or other stabilization measures.

MAINTENANCE

Sediment basins should be readily accessible for maintenance and sediment removal. They should be inspected after each rainfall and be cleaned out when about half the volume has been filled with sediment. Poorly draining basins require maintenance to clean clogged riser or filter cloth. Removed sediment should be disposed of and stabilized in an approved location such that spoils do not re-enter waters of the state. Sediment may not be dumped into any water of the U.S. without appropriate permitting.

The sediment basin should remain in operation and be properly maintained until vegetation or other measures permanently stabilize the drainage area. A well built temporary sediment basin that is large enough to handle the post-construction runoff volume may later be converted to use as a permanent storm water management structure.

If the pond is located near a residential area, it is recommended for safety reasons that a sign be posted and that the area be secured by a fence.